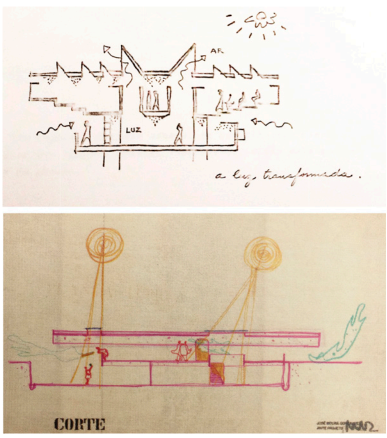
The representation of the sun in Paulo Mendes da Rocha and Decio Tozzi architectural drawings

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Abstract

Hygiene and health are themes that have been debated since the 18th century. The sun has become an essential element in modern architecture, not only for providing natural light, but as an immaterial and poetic element. The drawing of the sun will be represented in different ways by architects during the 20th century. The sun appears with emphasis in the drawings of Le Corbusier. Inspired by the French architect, the sketches by the Brazilian modern architect Decio Tozzi reveal the role of representation of the sun to expose the path of the rays that penetrate the building's interior. The section drawings show the contrast between the illuminated and shaded areas. On the other hand, the architect Paulo Mendes da Rocha, in his projects, represents the movement of light and shadow during the day, conceiving buildings that seem to float above the ground. In his drawings we can see the emphasis on the representation of the sun, in order to demonstrate how the rays fall on the building and, consequently, the expressive shadow projected from this relationship. Both architects explore the drawing of the sun to justify the design of the openings, such as skylights and windows. In addition, the sun representation contributes to adding a diagonal, tensioning the composition. In this article, the original contribution is to show how the drawing of the sun defines the phenomenology of space, contributing to articulate and organize the forces in the representation of both architects.

Keywords
Sketch, Light, Phenomenology, Design Process, Modern Architecture



Representation of the sun in sketches (Decio Tozzi's archives 2021; PMR's archives 2018).

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Introduction

"Numa folha qualquer eu desenho um sol amarelo."
(In any piece of paper, I draw a yellow sun) (Words for the song *Aquarela*)

Hygiene and health are themes that have been debated since the 18th century. The therapeutic power of the sun and, therefore, well-lit, and ventilated environments have become an increasing part of architects' concerns. With the development of Modern Architecture and the possibility of creating large openings such as windows, spans, and the fluidity of internal space, architectural solutions could meet society's demands.
Thus, the sun became an essential element in architectural design and not only for the natural light as an immaterial element, but the sun itself will be represented in different ways by architects during the 20th century.
This research started with observing how the sun is represented in the drawings of architects working in São Paulo, Brazil, especially those who studied in the College of Architecture of Mackenzie University in the 1950s and 60s. After verifying how the sun is represented in the drawings of these architects, we started searching for and organizing this material obtained from primary sources. Additionally, we have collected statements from the architects themselves about the sun in their architecture.
This paper is organized into five parts: i) Introduction; ii) The representation of the sun in Modern Architecture; iii) The representation of the sun by Decio Tozzi; iv) Paulo Mendes da Rocha; v) Discussion, and Final remarks.

Representation of the sun in Modern Architecture

"Sunset and sunrise are the front and back of the same phenomenon: while we who are on this side see the sunset, those who are there see the sunrise" [Bruno Munari. *Il disegno di sole*]
Representation of the sun in the drawings of Modern Architecture already appear in the designs of Le Corbusier (fig. 01). The architect's drawings express the movement of light and



Fig. 01. Illustration from the book '*Le poeme de l'angle droit*.' http://www.fondationlecorbusier.fr/corbuweb/morpheus.aspx?sysId=13&IrisObjectId=6474&sysLanguage=en-en&itemPos=19&itemCount=47&sysParentId=25&sysParentName= (Illustration from the 'ideal home' exposition, in London (1938-39). http://www.fondationlecorbusier.fr/corbuweb/morpheus.aspx?sysId=13&IrisObjectId=5790&sysLanguage=en-en&itemPos=134&itemCount=215&sysParentName=&sysParentId=65 Le Corbusier. Complete works).

shadow provided by the Earth's rotation around the sun and the passing of time. "Observing the sun's extreme speed is to notice how fast and fleeting our life is and how irreparable the lost time is". [Corbusier 1994, p.19.]
On the theme of the sun in Corbusier's poetics, Daniel Siret (2012) observes that there are three large periods we can identify. First, in the 1920s, the subject of the sun is mainly absent, both in his written work and in projects. Then, starting in the 1930s and until the 1940s, we identify many studies and experiments related to the sun, which are related to urban hygienic demands, and culminate in the Ville Radieuse project. Third, in the 1940s,

we observe studies of architectural elements such as the brise-soleil, plastically exploring the effects of sunlight in his proposals.
And in "*The Athens Charter,"* the architect exposes the problems of urban planning and the relationship with good solar radiation for a healthier life.
André Wogenscky [2007, p.47] highlights the importance of the sun in Corbusier's architecture, quoting a phrase by the architect in the book 'The Poem of the Right Angle': "A punctual rotating machine, since time immemorial, the sun gives birth to gradation and nuance at every instant of the 24 hours, and the imperceptible almost gives them their measure. But he breaks this measure abruptly, twice, in the morning and the evening. Continuity belongs to him, while he imposes on us an alternative - night, day - the two times that regulate our destiny: the sun rises, the sun sets, the sun rises again".
About the modern house, Corbusier (1994) says:
"Light and air will enter the house. What an accomplishment! The front yard and the back yard become one. What a gain of space, what a feeling of well-being! The house will appear as if suspended. What architectural purity! Further on, the architect complements: A solarium provides health". [Corbusier 1994, p.54].
Stanislaus von Moos [1979, p.99] also observes the importance of sunlight in Corbusier's architecture. "Other architects would have relied on electric power, not so Le Corbusier: to him, even a cavern only exists architecturally speaking, as a result of the sun."
Moos [p.162] also observes how vital the sun is in promoting people's health and how this is presented in Corbusier's architecture through a new area, the solarium, or the well-known garden terrace. "The roof is a solemnity that transcends the ordinary purpose: the roof is a stage set for the rituals of a secularized sun cult."
Corbusier has inspired generations of architects. The sun became part of the architectural composition in the work of many modern architects. As we will see further on, the sun's representation suggests and reveals important conceptual, symbolic, and functional characteristics to be analyzed and discussed.

Decio Tozzi. The representation of the sun and the play of light and shadow

Decio Tozzi (1936-) is an architect who graduated from Mackenzie University in 1960 and has important projects and works in the state of São Paulo. Since he started working, the architect proposed to develop an architecture based on a plastic and sensitive ideal formed by light, space, and matter [TOZZI 2005, p. 315]. The primary references we have verified in Tozzi's architecture are from Vilanova Artigas, Oscar Niemeyer, and Louis Kahn.
Among Tozzi's best-known works, we highlight the Romeu Del Negro Residence (São Paulo, 1965), the Santos Technical School (Santos, 1966-1969), and the Ruy Barbosa Labor Forum (São Paulo, 2004).
The drawings and sketches by Tozzi that we have analyzed demonstrate the characteristics he has pointed out: a) indoor-outdoor relationship; b) surrounding landscape views; c) rhythm resulting from the modulation of beams and serial elements; d) large clear spans; e) trapezoidal or cylindrical columns; f) zenithal lighting to capture and filter light in internal spaces, and especially the design of the sun. These elements, this "rationality" (a term used by the architect) of this large shelter, provided him with the desired architectural expression.
The architect has given several statements highlighting the importance of the sunlight that penetrates the internal spaces of his projects.
In the following figure, we verify that Tozzi draws the sun symbolizing and representing several aspects with which he was concerned. Pergolas and wide eaves protect and manipulate light in relation to the interior of the building, demonstrating the architect's concern for the well-being and the relationship with nature in his architecture.
His sketches [Tozzi 2005] reveal the leading role of the sun's representation, which emits light rays that penetrate the building's interior. The section drawings show the contrast

between the areas illuminated by the sun's rays and reflective rays inside the internal environments and the shaded areas. Human figures are drawn inside the buildings with arrows indicating hot air going up and out through the zenithal lighting and ventilation.
As Le Corbusier used to do, and in the same Modern Architecture tradition, Tozzi draws vertical sections that allow for studying and observing how height, structure, openings, and inside and outside areas relate to each other. For example, while working on the project for the Santos Technical School, Tozzi asked the following question:
"When we went to visit the terrain where the school was to be designed and given the climate conditions of the region that indicate the tropical characteristics of excessive light and high temperature with little air circulation, we asked ourselves: how can we, architects from underdeveloped countries, contribute to the process of mastering and transforming adverse nature situations into conditions favorable to human activities using available technology incorporated into our culture, without importing sophisticated and inadequate technologies that cause currency evasion and violate our culture?" [Tozzi 1981, p.132].
Santos is a city on the coast of the state of São Paulo, with a hot and humid climate. From this moment on, Tozzi begins to explore zenithal openings as a strategy to manipulate sunlight and solve problems related to natural light in a tropical climate. The sketches for the Santos Technical School and the Romeu Del Negro Residence present the possibility of transforming "adverse nature situations into conditions favorable to human activities" using zenithal openings that can filter sunlight and, at the same time, create conditions for air circulation.
In (fig. 02), the words "light" and "air" reinforce the importance of controlling climate conditions inside the building located in the city of Santos.
The arrows complete the sketches, indicating ventilation through zenithal and lateral openings. Thus, the "transformed light" coming from the sun penetrates the building through constructive control elements.
The light from above penetrates the building, passes from one floor to the next, and certainly surprises those who stop and notice this natural phenomenon.
In the Romeu Del Negro Residence section drawing (fig. 03), the sun's rays produce an unusual effect. First, the sunbeams enter the zenithal opening in the roof, pass through a cylinder in the entrance floor of the house, and then reach the lower floor, where the kitchen is located. In this sketch, Tozzi once again represents the contrast between light and shadow caused by sunlight that directly or indirectly hits indoor areas of the house.
The architectural forms are exposed to the sun. Thus, the play of light and shadow resulting from the intense sunlight emphasizes the quality of the matter with which architecture is made.
Tozzi's restlessness was partially resolved with zenithal openings, causing the abundance of tropical light to be filtered, allowing for direct and diffused light to be generated.
In the section sketch (fig. 04) of the Baeta Neves District Stadium (1971), Tozzi draws the sun and rays that reflect on the floor and penetrate the inside area of the gymnasium.
In the Eduardo Alvaro Vieira Residence (1974) (fig. 05), the expressive section sketch shows the essence of the structure with the sun above. The pergola intersperses light and projected shadow:
"The shaded protection of the balconies shapes the design of the structure that defines its shape and surprises the city with its unusual configuration". [Tozzi 1981, p.256].
Like other renowned Brazilian architects, such as Niemeyer and Reidy, the vertical section drawing of the cantilevered trapezoidal shape contributes to the proper handling and direction of sunlight.
The section drawing of the Geraldo Abbondanza Neto residence (1989) (fig. 06) reveals the cause-and-effect relationship between the sloping roof and the sun above it.
With this research, we have understood that the sun's representation in Decio Tozzi's drawings is related to the conceptual basis of his architecture as an element that composes a significant part of the design and, therefore, should be represented in the sketches.

Paulo Mendes da Rocha. The representation of the sun in the design of architecture in the landscape

"Architecture does not aspire to be functional but opportune" [Mendes da Roch 2000, p.73]
Paulo Mendes da Rocha (1928-2021) is an architect who graduated from Mackenzie University in 1954 and has important projects and works in various cities worldwide. The relationship between architecture and engineering, art and technique, is essential for understanding the work of Paulo Mendes da Rocha.
The architect conceives buildings that seem to float above the ground, with expressive materiality that appears to defy gravity. In this sense, in the drawings, we can observe the sun, its rays falling on the building, and the expressive shadow projected from this relationship.

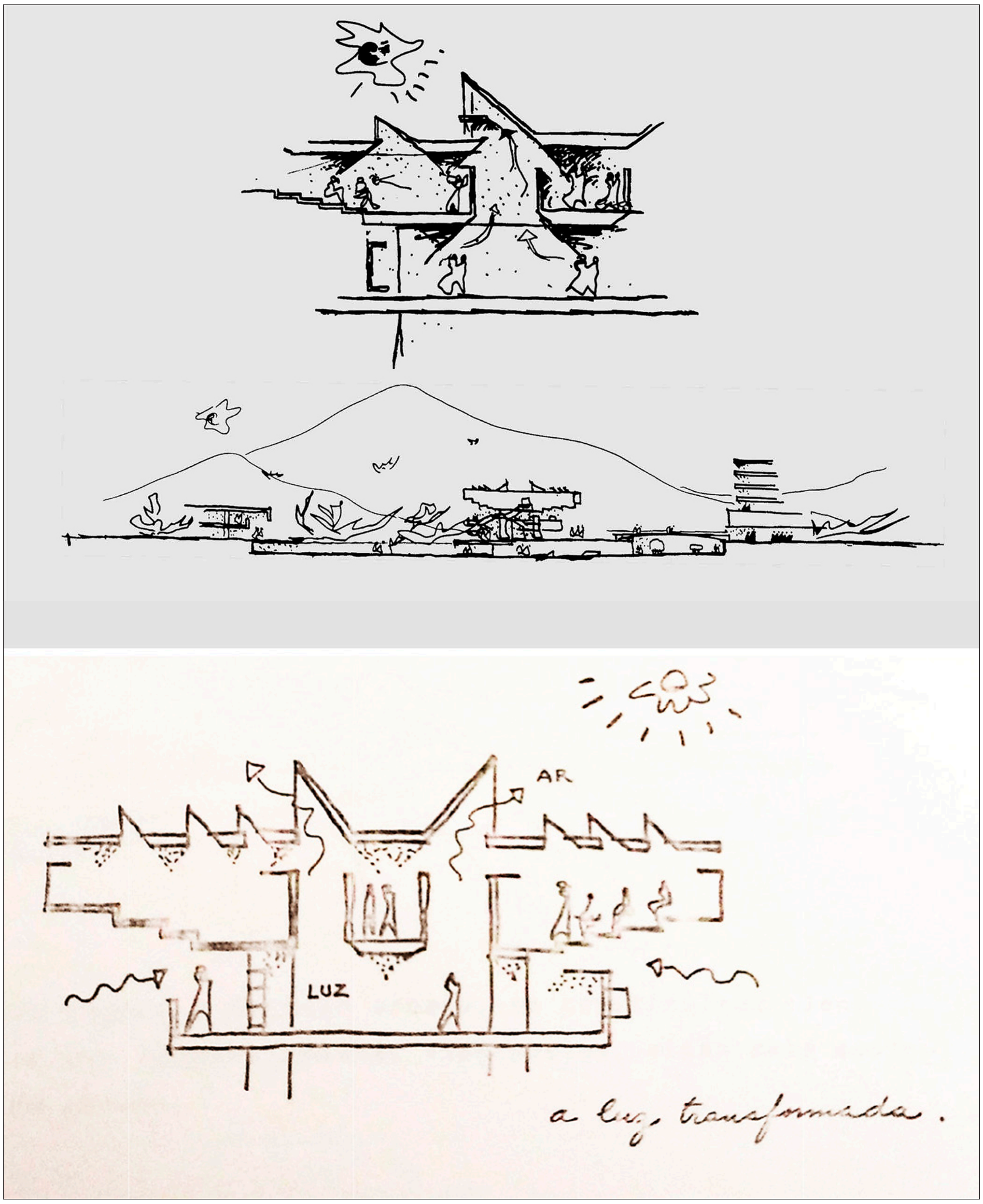


Fig. 02. Sketches for Santos Technical School. (Decio Tozzi's archives 2021).

Following the precepts of Modern Architecture, we see in Paulo Mendes da Rocha's designs intentions and solutions related to sunlight. These solutions comprise from elements such as brise-soleils, pergolas, and marquees, to problem-solving design strategies such as using zenithal openings and inclined façades to control the incidence of sunlight, among others.
In the book *'Casa Butantã,'* Catherine Otondo [2016, p.30] observes that the house's bedrooms are located in the middle of the floor plan, with no windows in the wall, but rather in the ceiling. "When there is a full moon, the room turns blue. In the afternoon, it seems golden. It changes colors all the time".
We can say that Paulo Mendes da Rocha's architecture shown in the drawings (figs. 07-10)

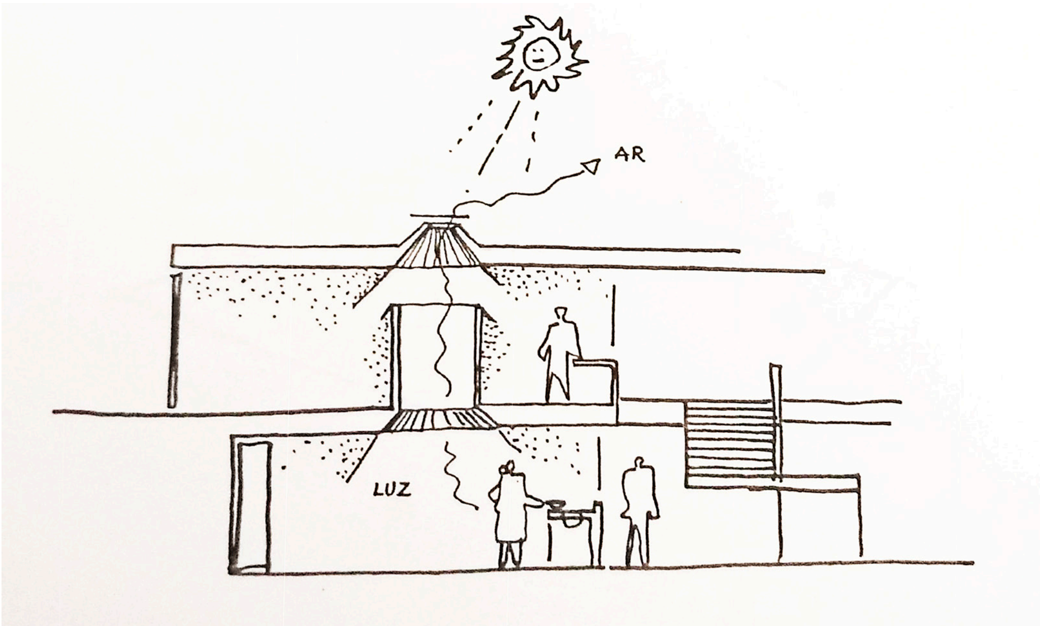
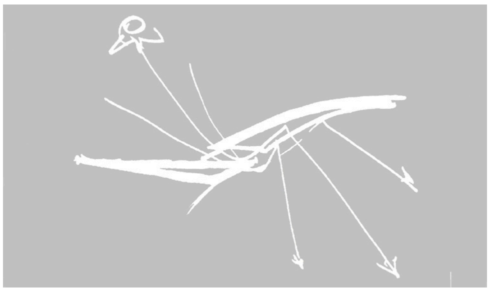


Fig. 03. Sketch of the Romeu Del Negro Residence. (Decio Tozzi's archives 2021).



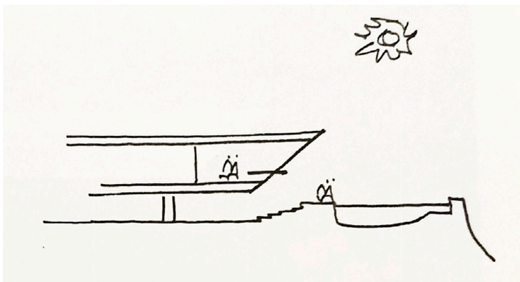


Fig. 04. Sketch of the Baeta Neves District Stadium. (Decio Tozzi's archives 2021).

Fig. 05. Sketch of the Eduardo Alvaro Vieira Residence. (Decio Tozzi's archives 2021).

is the architecture of movement. The movement of people through the space, along the building's ramps; the movement of leaves on the trees in the wind; the movement of light and shadow during the day, indicated primarily by the incidence of sunlight.
Denise Solot [2020, p.131] analyzes that in the Gerassi house, "the entrance of natural light is reinforced by the central skylight, whose dimension projects into the floor slab formed by hollow cement blocks, allowing a view and ventilation from the first floor." Therefore, the sun lights the top floor and the ground floor.
From the drawings and projects analyzed, we can say that the representation of the sun in the drawings of Paulo Mendes da Rocha's architecture is directly linked to the incidence of

natural light into the building and the alleged presentation by the drawing of the justification for specific projected openings.
Sobreira, Flynn, and Ribeiro [2018, p.37] present an interview with the architect on the subject of architecture competitions. Regarding the *Clube da Orla*, Paulo Mendes says: "It doesn't seem like an invented form of a new spatiality that solves everything, so much so that the sun is here, the shadow... the great virtue of this is this area of shadow".

Conclusions

Based on this research, we can say that for Tozzi, the sun is an immaterial element that is part of the composition and design process in architecture. While for Paulo Mendes, the sun is related to modern concepts of hygiene, health, and the movement, dynamics, and journey of the day.

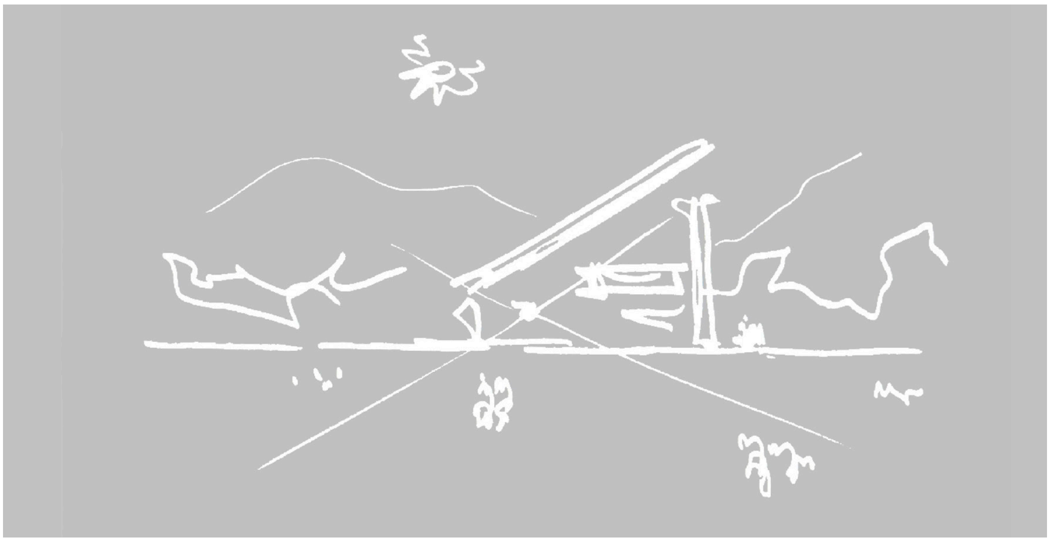


Fig. 06. Sketch of the Geraldo Abbondanza Neto Residence. (Decio Tozzi's archives 2021).

Therefore, we have two spheres of discussion on the theme: i- What the sun means and what message it sends through the drawing, in other words, the concepts and intentions in the architecture of each architect; ii- The sun in the structure of the drawing, how it is represented and how it relates to the drawn set.
The sun articulates and organizes the forces in the drawing, attracting the eye. The sun

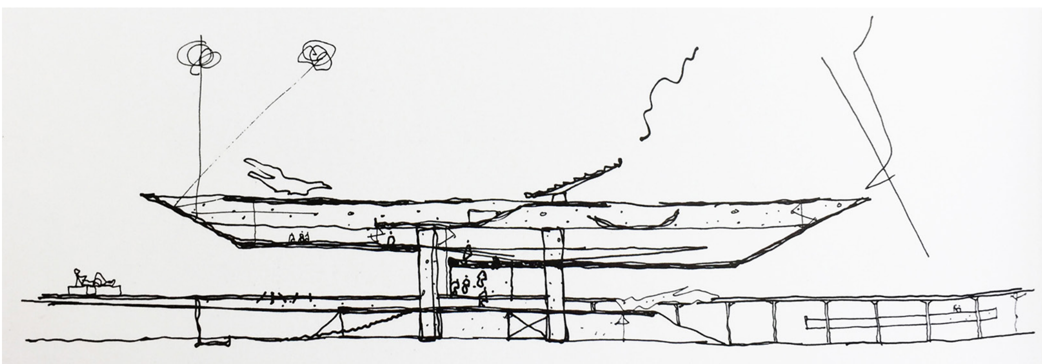


Fig. 07. Sketch of the Museum of Contemporary Arts. (PMR's archives 2018).

participates in the representation and contributes to adding a diagonal, tensioning the composition. In Mendes da Rocha's drawings, the tension between the horizontality of the buildings and the verticality caused by representations of elements of nature such as palm trees and the diagonal with the sun and its rays is evident. Therefore, a relationship of tension is created between the orthogonality and diagonality of the sun's ray.

The drawing of the sun defines the phenomenology of space, causing sensations and perceptions, highlighting the relationship between tectonics and nature.

The sun represented in the drawings indicates alleged justifications for solutions designed in the matter, such as brise-soleils, eaves, marquees, and cantilevers.

Therefore, the presence of the sun in the drawings indicates the dynamics, movement, and journey of the day. For sure, the sun is more than merely an informative drawing; it is symbolic in the context of Modern Architecture.

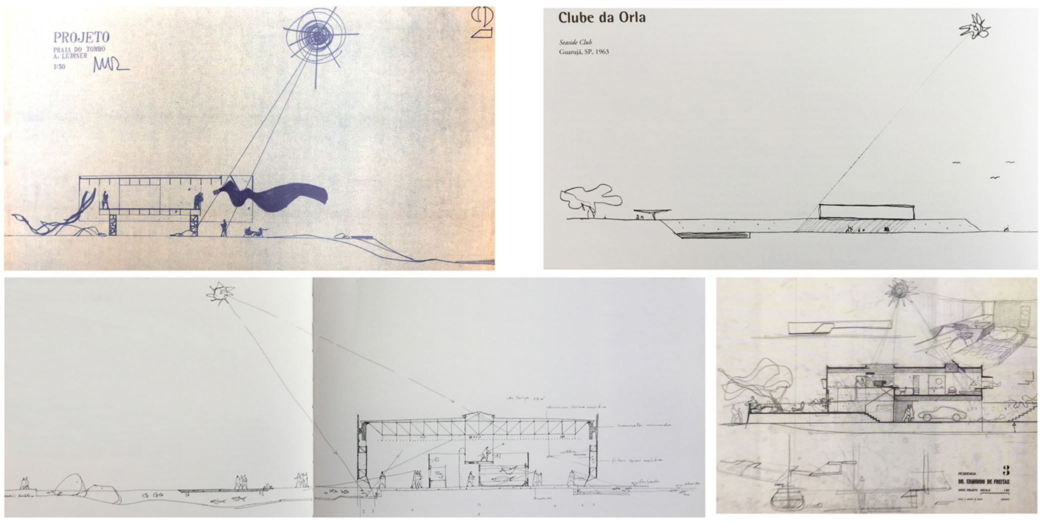


Fig. 08. Sketches of designs by Paulo Mendes da Rocha. (PMR's archives 2018).

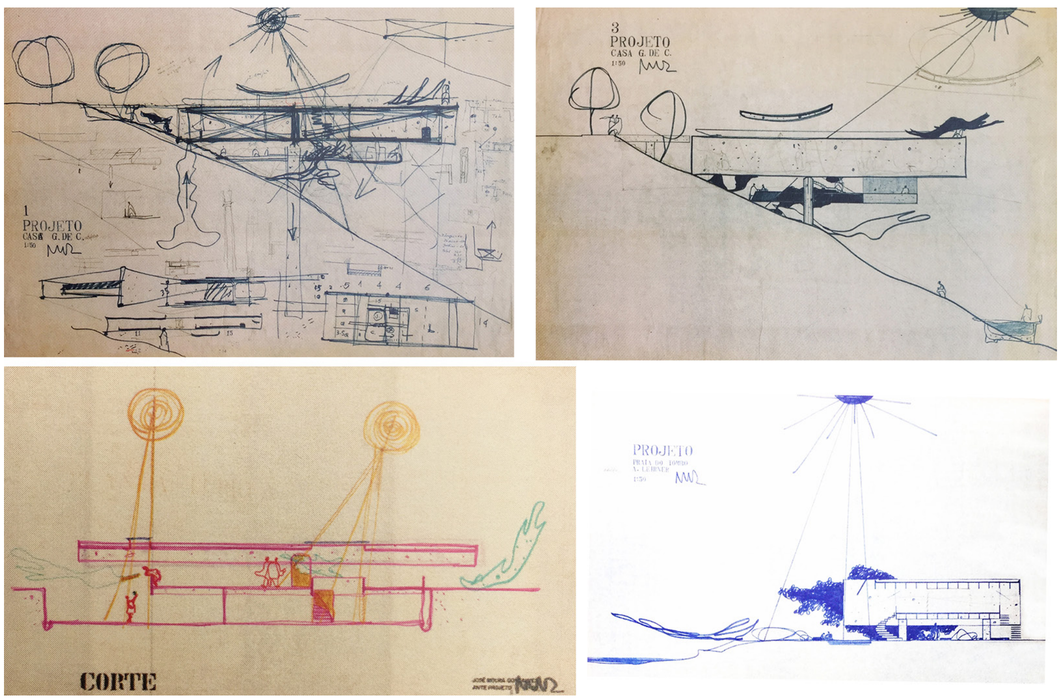


Fig. 09. Sketches by Paulo Mendes da Rocha. (PMR's archives 2018).

In the drawings, we can see that the sun, and the rays that fall on and through the building through the openings, reveal the fluidity of space, quality of Modern Architecture, the solidity of matter, usually concrete, and the lightness of light, an immaterial element, highlighting the relationships of light and dark, and the effects of light and shadow.
Undoubtedly, the representation of the sun in the drawings of Tozzi and Mendes da Rocha's architecture indicates design intentions, which are inherent concerns regarding the understanding of architecture and nature.

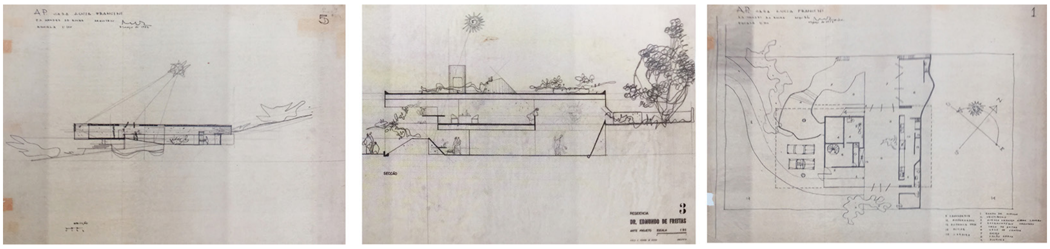


Fig. 10. Sketches of designs by Paulo Mendes da Rocha. (PMR's archives 2018).

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